[0029] FIG. 7 is a cross-sectional view of a structure of a unit pixel of a stacked image sensor according to another exemplary embodiment.

DETAILED DESCRIPTION

[0030] Exemplary embodiments are described in greater detail below with reference to the accompanying drawings.

[0031] In the following description, like drawing reference numerals are used for like elements, even in different drawings. The matters defined in the description, such as detailed construction and elements, are provided to assist in a comprehensive understanding of the exemplary embodiments. However, it is apparent that the exemplary embodiments can be practiced without those specifically defined matters. Also, well-known functions or constructions are not described in detail since they would obscure the description with unnecessary detail.

[0032] It will be understood that when an element or layer is referred to as being "on" another element or layer, the element or layer may be directly on another element or layer or intervening elements or layers.

[0033] FIG. **1** is a plan view of a unit pixel of a stacked image sensor **100** according to an exemplary embodiment. FIG. **2** is a cross-sectional view taken along a line II-II' of FIG. **1**.

[0034] Referring to FIG. **1**, a pixel unit PU may include two green pixels G, a red pixel R, and a blue pixel B. FIG. **1** shows a Bayer pattern as an example, but the exemplary embodiment is not limited thereto. For example, the locations of the color pixels R, G, and B may be different from those shown in FIG. **1**. Also, the pixel unit PU may include cyan, yellow, green, and magenta pixels. The stacked image sensor **100** may include a plurality of pixel units PU arranged in an array.

[0035] Referring to FIG. **2**, the pixel unit PU may include a first photoelectric conversion layer **110**. A second photoelectric conversion layer **130**, a color filter layer **150**, and a micro-lens layer **170** are sequentially stacked on the first photoelectric conversion layer **110**.

[0036] The first photoelectric conversion layer **110** and the second photoelectric conversion layer **130** may be disposed in a silicon layer **140**. The first photoelectric conversion layer **110** may include first photoelectric conversion regions **112** respectively disposed in the corresponding pixels. Each first photoelectric conversion region **112** may include a plurality of third photoelectric conversion regions **114**. Each first photoelectric conversion region **112** may include two to four third photoelectric conversion regions **114**. The first photoelectric conversion region **112** may include two third photoelectric conversion regions **114**.

[0037] The second photoelectric conversion layer **130** may include one second photoelectric conversion region **132** at the corresponding pixel. The two third photoelectric conversion regions **114** and the second photoelectric conversion region **132** in one pixel may be doped regions. For example, the silicon layer **140** may be doped with a first type impurity, and the third photoelectric conversion regions **114** and the second photoelectric conversion region **132** may be regions doped with a second impurity. When the first impurity is an n-type impurity, the second type impurity may be a p-type impurity, and vice versa.

[0038] The second photoelectric conversion region **132** may be a general image detection region. The third photoelectric conversion regions **114** may perform auto-focusing by detecting light passing through the second photoelectric conversion region **132** thereon. That is, the two third photoelectric conversion regions **114** in the pixel may perform phase detection auto-focusing (AF).

[0039] The third photoelectric conversion regions **114** may be also used as image detection regions.

[0040] The color filter layer **150** may include a plurality of color filters **150**R, **150**G, and **150**B. In the red pixel R, the red color filter **150**R is disposed on the second photoelectric conversion region **132** to selectively transmit red light. In the green pixel G, the green color filter **150**G is disposed on the second photoelectric conversion region **132** to selectively transmit green light. In the blue pixel B, a blue color filter **150**B is disposed on the second photoelectric conversion region **132** to selectively transmit blue light.

[0041] The micro-lens layer **170** may include a plurality of micro-lenses **172**. The micro-lenses **172** are disposed on each of the color filters **150**R, **150**G, and **150**B to collect incident light and to transmit collected light to the corresponding color filters **150**R, **150**G, and **150**B.

[0042] The stacked image sensor **100** may include first barriers **181** that divide the pixels R, G, and B. The first barriers **181** may vertically pass through the first photoelectric conversion layer **110** and the second photoelectric conversion layer **130**. The two third photoelectric conversion regions **114** and the second photoelectric conversion region **132** corresponding to the pixel may be disposed in a pixel region surrounded by the first barriers **181**.

[0043] FIG. **3** is a cross-sectional view showing a structure of the first barrier **181** of FIG. **2**. Referring to FIG. **3**, each first barrier **181** may include a trench T that separates the pixels R, G, and B, an insulating layer **191** that covers an inner wall of the trench T, and a light absorption layer **192** that fills a hole formed by the insulating layer **191**. The insulating layer **191** may be formed of thin silicon oxide. The light absorption layer **192** may be formed of, for example, polysilicon.

[0044] A second barrier **182** that separates the two third photoelectric conversion regions **114** in each of the pixels R, G, and B may be disposed in the first photoelectric conversion layer **110**. The second barrier **182** may have the same structure as the first barriers **181** of FIG. **3**, and the detailed description thereof will not be repeated.

[0045] The first barriers **181** and the second barrier **182** prevent incident light on a pixel from entering other adjacent pixel regions that causes a noise. That is, the insulating layer **191** reflects light that enters adjacent pixels after entering into a pixel, and light transmitted through the insulating layer **191** may be absorbed by the light absorption layer **192**.

[0046] The stacked image sensor **100** may further include a signal processor that processes an electrical signal by receiving charges from the photoelectric conversion regions. The signal processor may include three to four transistors. The signal processor may be disposed below the first photoelectric conversion layer **110**.

[0047] When visible light enters the stacked image sensor **100** from an image measuring object, red light of visible light passes through the red color filter **150**R and generates charges in the second photoelectric conversion region **132**. Based on the generated charges, the signal processor outputs an intensity signal of the red light. Green light and blue light of visible light enter the corresponding second photoelectric conversion region **132** respectively through the green color filter **150**G and the blue color filter **150**B and generate